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EFFECTS OF DRIP IRRIGATION AND POLYTHENE MULCH ON PRODUCTIVITY AND QUALITY OF STRAWBERRY (*Fragaria ananassa*)

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ABSTRACT: A field trial was conducted under farmer's participatory research project at farmers' field in the Bhojpur district of Bihar on clay loam soil to improve strawberry (*Fragaria ananassa*) productivity and quality through drip irrigation and polythene mulch and to enhance water use efficiency through pressurized irrigation coupled with use of black polythene mulch along with surface irrigation. Drip irrigation with polythene mulch gave significantly highest yield (50.10 q ha^{-1}) as compared to surface irrigation in an unmulched condition (40.15 q ha^{-1}) however, the yield under paddy straw (45.90 q ha^{-1}) and unmulched (42.07 q ha^{-1}) was next in order to drip with polythene mulch but were significantly at par among themselves. When calculated the percentage increase the drip with polythene mulch gave 25 per cent higher yield than surface with unmulched condition. Similarly, the water use efficiency (WUE) was highest in drip irrigation with polythene mulch (7.7 kg ha^{-1} mm^{-1}) as compared to surface irrigation (5.1 kg ha^{-1} mm^{-1}). The fruit yield of strawberry under drip irrigation was found to be 46.07 q ha^{-1} compared to 40.15 q ha^{-1} under surface irrigation. Moreover, polythene mulch plus drip irrigation further raised the yields. Fruit weight increased significantly while other analyzed quality characteristics did not differ significantly among treatments. Drip irrigation besides giving a saving of 50-55 % irrigation water resulted in 20-40 % higher yield of crops studied.

Keywords: *Drip irrigation, mulch, black polythene, WUE, fruit yield, fruit quality*

Micro (Drip) irrigation system has proved its superiority over other conventional methods of irrigation, especially in horticultural crops (fruit crop), owing to precise and direct application of water in the root zone. A considerable savings in water and fertilizer use besides increased growth, development and yield of vegetable crops under drip irrigation have been reported (Bhella, 2; Malik *et al.*, 3). The use of black polythene mulch in fruit and vegetable crops has been reported to control the weed incidence, reduce nutrient losses and to improve the hydro-thermal regime of soil (Ashworth and Harrison, 1; Raina *et al.*, 5). Strawberry, being a shallow rooted plant requires more frequent but less amount of water for each irrigation, which can be accomplished more efficiently through drip system. The consequences of drip irrigation in this crop have not yet been completely established. The present studies were, therefore, undertaken to evaluate the effect of drip irrigation alone and in conjunction with polythene mulch compared to surface irrigation on water use efficiency, yield and quality of strawberry. Considering the additional cost of inputs and the selling price of the quality produce, the polythene mulch with drip irrigation may be recommended to the more progressive farmers for cultivation of strawberry in Bihar. However grass mulch can also be used to make technology more resource crunched farmer friendly intervention for cultivation of strawberry especially under Bihar socio-economic condition. The strawberry is the most profitable fruit crop in the shortest possible time as compared to other fruits.

By spending 1.5 lakhs ha^{-1} one can get a receipt of Rs. 2-3 lakh ha^{-1} in strawberry. It can be grown on any type of soil, poor sand to heavy clay provided proper moisture organic matter and drainage is present. It is a short day plant (about 10 days of less than 8 hours sunshine for initiation of flowering). In winter the plants don't make any growth and remain dormant. In spring, when days become longer and temperature rises, the plants resume growth and begin flowering.

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MATERIALS AND METHODS

Field trial was conducted under farmer's participatory research project in the farmers' field in the Bhojpur district of Bihar on clay loam soil having pH 6.43, E.C. 0.13 dSm^{-1}, organic carbon 0.86 %. The available N, P and K were 203.06; 551.6 and 14.73 kg ha^{-1}, respectively with twin objective : (1) to improve strawberry (*Fragaria ananassa*) productivity and quality through drip irrigation and polythene mulch and (2) to enhance water productivity through pressurized irrigation coupled with use of black polythene mulch along with surface irrigation. Treatments comprised of two irrigation schedules (drip and surface irrigation) and three mulches viz., black polythene (25 micron), paddy straw (4.0 t ha^{-1}) and unmulched conditions. These treatments were tested in 2 m x 2 m raised bed plots (each plots consisted of 10 beds) arranged in randomized block design (RBD) with six replications. Treatment denoted as under *i.e.* T_1 = Surface irrigation (S_1) + unmulch; T_2 = S_1 – paddy straw; T_3 = S_1 – Black polythene mulch; T_4 = Drip irrigation (D_1) + unmulch; T_5 = D_1 – paddy straw; T_6 = D_1 – Black polythene mulch (BP).

RESULTS AND DISCUSSION

Effects of drip irrigation and polythene mulch on strawberry runner production :

Drip irrigation without mulch and with paddy straw mulch significantly increased the runner production. However, with drip plus BP mulch it was reduced significantly compared with surface irrigation (Table 1). Since the black polythene could not provide an anchor for the roots of the new runners, this impeded their production. It is therefore, suggested that after crop harvest, black polythene be removed to provide favourable soil environment for higher runner production.

Effects of drip irrigation and polythene mulch on strawberry fruit yield:

The data on strawberry fruit (Table 1) indicate that the drip irrigation without mulch increased the fruit yield by about 21.0 and 9.0 % over surface irrigation. The corresponding values with paddy straw mulch were 15 and 10 %. Maximum fruit yield was observed under drip with BP mulch and increase in yield of 22 % over the surface irrigation plus BP mulch (Table 1). These results are in accordance with the findings of Rolbiecki *et al.* (6) who observed higher Strawberry yield under drip compared to surface irrigation. Both the mulches were found to be effective in increasing the yield over un-mulch treatment. Surface irrigation with paddy straw and BP increased the yield by about 18 and 37 % respectively, over the un-mulch plots (Table 1). The higher yields observed under different mulches may be explained in the light of results reported by Raine *et al.* (5). They observed that the paddy straw and polythene mulches are effective in altering the soil hydrothermal regimes, thus providing a favourable soil environment for enhanced root shoot growth and the nutrient uptake by strawberry. Higher yield under mulch treatments may be ascribed to its favourable effects on weed control.

Drip irrigation with polythene mulch gave significantly highest yield (150.10 q ha^{-1}) as compared to surface irrigation in an unmulched condition (40.15 q ha^{-1} ; 15.01 t ha^{-1}), however, the yield under paddy straw (45.90 q ha^{-1}) and unmulched (42.37 q ha^{-1}) was next in order to drip with polythene mulch but were significantly at par among themselves. When calculated the percentage increase the drip with polythene mulch gave 25 per cent higher yield than surface with unmulched condition. The use of black polythene mulch in strawberry has been reported to control the weed incidence, reduce nutrient losses and improves the hydro-thermal regime of soil. Strawberry, being a shallow rooted plant requires more frequent but less amount of water for each irrigation, which can be accomplished more efficiently through drip system. Polythene especially black polythene mulch contributes significantly to control leaf spot disease. Higher yield under mulch treatments may be ascribed to its favourable effects on weed

Table 1: Effect of irrigation and mulch treatments on fruit and dry matter yield and quality characteristics of strawberry fruits.

Treatments	Berry weight (g)	Fruit yield (kg ha^{-1})	Runner production plant	TSS (%)	Acidity (%)	TSS/Acid ratio
T_1	5.0	4035	11.3	7.17	0.82	8.79
T_2	6.8	4154	07.5	6.75	0.73	9.28
T_3	6.3	3361	7.15	6.98	0.78	9.01
T_4	6.1	4207	10.6	7.06	0.82	8.78
T_5	8.4	4590	11.5	6.66	0.72	9.59
T_6	7.0	5010	12.5	6.86	0.77	9.37
C.D. (P = 0.05)	0.3	56	1.2	0.37	0.08	0.87

Table 2: Effect of irrigation and mulch treatments on strawberry water use efficiency.

Treatments	Water Use Efficiency (kg ha^{-1}mm^{-1})		
	Ist year	IInd year	Pooled
T_1	3.8	3.6	3.7
T_2	4.9	4.6	4.7
T_3	6.3	5.9	6.2
T_4	6.2	6.7	6.5
T_5	7.2	7.4	7.3
T_6	10.5	10.3	10.4
C.D. (P = 0.05)	1.2	1.7	1.5

control. Quality fruits were harvested due to infestation free crop. Results show that there was 85 per cent weed control was achieved under black polythene mulch as compare to weedy check plot. Mulching could save precious labourer as it requires frequent weeding @ 15 days interval during the growing season. Considering the additional cost of inputs and the selling price of the quality produce, the polythene mulch with drip irrigation may be recommended to the more progressive farmers for cultivation of strawberry in Bihar. However, grass mulch can also be used to make technology more resource crunched farmer friendly intervention for cultivation of strawberry especially under Bihar socio-economic condition. The corresponding figures for water savings and increase in yield for strawberry were 51 and 19%, respectively.

The results further document that irrigation requirement of Strawberry can be met effectively by operating the drip system having discharge rate of 4 lit h^{-1} biweekly during the growing season.

Effects of drip irrigation and polythene mulch on production and fruit quality:

Drip irrigation without mulch and with paddy straw mulch significantly increased the runner production. However, with drip plus black polythene mulch it was reduced significantly compared with surface irrigation (Table 1). Since the black polythene could not provide an anchor for the roots of the new runners, this impeded their production. It is therefore, suggested that after crop

harvest, black polythene be removed to provide favourable soil environment for higher runner production.

Maximum fruit weight (8.4 g - fruit) was recorded under drip plus paddy straw treatment. It may be attributed to the fact that under paddy straw treatment, number of flowers and fruits was less than those under BP mulch (Raina *et. al.* 5). Drip plus paddy straw produced fruit with higher TSS acidity ratio. Comparable results regarding total soluble solids, sugar contents and titrable acidity were obtained by Mishra (4). In strawberry, drip irrigation without mulch increased the fruit weight by about 6 % over surface irrigation and when coupled with paddy straw and BP, the corresponding increase was 32 and 16%, respectively (Table 1).

Effects of drip irrigation and polythene mulch on water use efficiency (WUE):

The corresponding values for drip plus paddy straw and surface irrigation plus paddy straw were 6.8 and 4.7 kg ha^{-1} mm^{-1} and these values for drip plus polythene mulch and polythene mulch plus surface irrigation were 7.7 and 5.1 kg ha^{-1} mm^{-1} respectively. Highest water use efficiency of 7.7 kg ha^{-1} mm^{-1} was observed under drip plus black polythene mulch (Table 2). Drip system delivers water directly into the root zone without wetting the entire area, thus, probably resulted in higher water use efficiency compared to surface irrigation. Drip irrigation, both with and without polythene mulch registered higher water use efficiency (WUE) as compared to surface irrigation. Averaged overall level of irrigation, drip irrigation, without mulch gave water use efficiency of 5.5 (kg ha^{-1} mm^{-1}) against 3.7 (kg ha^{-1} mm^{-1}) under surface irrigation (Table 2).

CONCLUSION

It is concluded that, drip system is very effective and efficient method of irrigation for raising strawberry crop, especially on light texture soils and in water scarce areas. The corresponding figures for water savings and increase in yield for strawberry were 51 and 19%, respectively. The results further document that irrigation requirement of Strawberry can be met effectively by operating the drip system having discharge rate of 4 lit h^{-1} biweekly during the growing season.

REFERENCES

1. Ashworth, S. and Harrison, H. (1983). Evaluation of mulches for use in the home garden. *Hort. Sci.*, 18:180-182.
2. Bhella, H.S. (1988). Tomato response to trickle irrigation and black polythene mulch. *J. Am. Soc. Hort. Sci.*, 35 (4): 543-546.
3. Malik, R. S., Kumar, K. and Bhandari, A.R. (1994). Effect of urea application through drip irrigation system on nitrate distribution in loamy sand and pea yield. *J. Indian Soc. Soil Sci.*, 42 (2): 6-10.
4. Mishra, S. K. (1982). Standardization of the agro-techniques of strawberry (*Fragaria ananassa* Duch. ex Lamk). *Ph.D. Thesis*, HPKV, Palampur.
5. Raina, J.N. Thakur, B.C. and Sophia R. (2004). Effect of mulches on soil Hydrothermal regimes, root growth, yield and quality of strawberry. *Ind. J. Soil Res.*, 12: 6-30.
6. Reichelt, S., Rzekanowski, C., Scheer, D., Lieten, F. and Dijkstra, J. (1997). Influence of sprinkler and drip irrigation on the growth and yield of strawberry grown on sandy soils. *Acta Hort.*, 439: 867-872.